3. Respiration under Varying Temperatures.

A series of 18 snails was run for one hour at temperatures of 11°, 19°, 27°, and 35° C. during August, 1961. One hour was allowed for equilibration between 11° and 19°, two hours between 19° and 27°, and four hours between 27° and 35°. Average oxygen consumption of the 18 snails at each temperature is shown in Table 3.

Table 3:

Oxygen consumption (microliters per mg. dry weight) of *Tegula* at temperatures ranging from 11° to 35° C.

Temperature		11°	19°	27°	35°
Time (min.)	30	0.31	0.48	0.76	0.45
	60	0.54	0.95	1.45	0.92

Between 11° and 27° the respiratory rate appeared to increase directly with temperature. The upper limit of respiratory efficiency was reached between 27° and 35°, for the rate at 35° fell off to slightly less than the rate at 19°.

4. Effect of Starvation upon the Respiratory Rate.

The oxygen consumption of six animals collected 20 days previously was compared to the oxygen consumption of nine animals collected one day previously (August, 1961). The results are shown in Table 4.

Table 4:

Oxygen consumption (microliters per mg. dry weight) of *Tegula*, starved and fresh

		Starved	Fresh
Time (min.)	30	0.40	0.76
	60	0.84	1.47

Starved animals respired at slightly more than half the rate of the freshly collected animals. These results emphasize the importance, in experiments of this kind, of using animals collected at the same time and subjected to the same conditions.

Conclusions

These short determinations have indicated that respiratory activity of Tegula varies not unexpectedly with conditions of exposure, salinity, temperature, and starvation. Basic rates of oxygen consumption are comparable to those given for molluscan tissues by Zeuthen (1947). Additional factors which have been shown to affect respiratory activities of gastropods are seasonal variations (Berg, Lumbye and Ockelmann, 1958) and tidal and diurnal rhythms (Sandeen, Stephens and Brown, 1954). The shortness of the manometric determinations used here served to obscure rhythms that might have been present. Respiratory activity may also be expected to vary with the intertidal height from which the snails are collected. Manometric determinations of oxygen consumption, therefore, are useful only with snails collected at the same time and measured in the manometer simultaneously.

Literature Cited

Berg, K., J. Lumbye, & K. W. Ockelmann
1958. Seasonal and experimental variations of the oxygen consumption of the limpet Ancylus fluviatilis (O. F. Müller). Journ. Exp. Biol. 35: 43-75.

Galli, D. R., & A. C. Giese
1959. Carbohydrate digestion in a herbivorous snail, Tegula funebralis. Journ. Exp. Zool. 140: 415 to 440.

Sandeen, M. I., G. C. Stephens, & F. A. Brown, Jr.
1954. Persistent daily and tidal rhythms of oxygen consumption in two species of marine snails. Physiol. Zool. 27: 350-356.

Zeuthen, Erik
1947. Body size and metabolic rate in the animal kingdom with special reference to the marine microfauna. Compt. rend. Lab. Carlsberg, Sér. chim. 26 (3): 16-161.

A Study of Food Choices of Two Opisthobranchs, *Rostanga pulchra* McFarland and *Archidoris montereyensis* (Cooper)

BY

EMILY F. COOK

Department of Zoology, University of California, Berkeley 4, California

(4 Textfigures)

Several of the dorid nudibranchs of the west coast of North America feed on sponges which they resemble in color and texture. Rostanga pulchra MacFarland, a bright red nudibranch, 1.0 to 1.5 cm. long, feeds on an encrusting red sponge, Ophlitaspongia pennata Lambe, while Archidoris montereyensis (Cooper), a large yellow nudibranch, 6.0 to 10.0 cm. long, commonly feeds on a yellow sponge, Halichondria panicea (Pallas). Both the nudibranchs and the sponges on which they feed are found intertidally along rocky coasts.

In the Friday Harbor region (San Juan Island, Washington), where this work was done, the sponge, Ophlitaspongia pennata, is represented by the varietal form, O. pennata var. californiana de Laubenfels. In order to distinguish var. californiana measurements of the spicules must be made. Although this was not done, Mr. Gerald J. Bakus, who has worked on the sponges of the area, has assured me that the odds are about 100 to 1 that it will be the varietal form, since he has not found the typical form itself in the San Juan Archipelago.

In the field Rostanga pulchra is often found on red sponge and is seldom found far away from it. The sponge encrustations are 2 to 3 mm. thick and vary in area from 2 or 3 sq. cm. to over 100 sq. cm. It is scattered in its distribution along the coast.

Archidoris montereyensis is commonly found on Halichondria panicea but may be found where sponges appear to be absent. Halichondria panicea is a branching yellow sponge of a fairly loose composition, often found in large clumps. In the literature it is often referred to as the "bread crumb" sponge.

The purpose of this paper is to report on some aspects of feeding of Rostanga pulchra and Archidoris montereyensis.

This work was done at the Friday Harbor Laboratories, University of Washington, partially supported by N.S.F. Grant No. G-7045. I would like to express my appreciation to Dr. Gunnar Thorson for his many helpful suggestions during the course of this work, and to Dr. Cadet Hand for his criticism of the manuscript.

Materials & Methods

I. Three sets of experiments were done with Rostanga pulchra to determine factors important in location of food. A plastic bowl 10 inches in diameter was set up so that two currents could be directed into it. An overflow was placed between the two incoming currents (Figure 1). The bowl was covered with black rubber

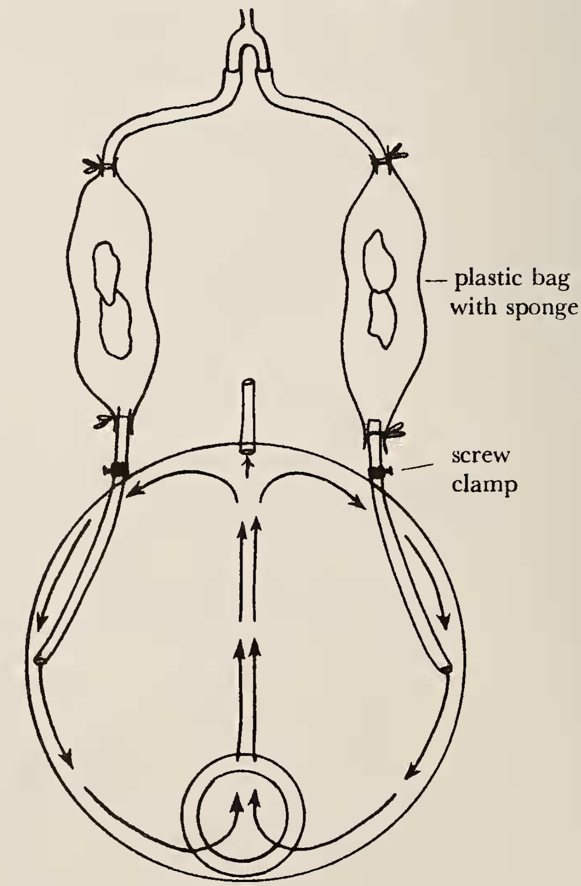

Figure 1

Apparatus used to test the response of *Rostanga pulchra* to food and current. The arrows indicate the direction of the current.

on the outside. During all experiments the bowl was covered with heavy cardboard to eliminate light. Screw clamps were used to adjust the flow of incoming water. For each experiment, except (a), 12 animals were started in a watch glass midway between the two currents. Each experiment lasted 30 minutes. The cover was lifted at 10-minute intervals to observe the progress of the animals.

(a) Two experiments, using 12 and 13 animals, were done to test the response of Rostanga pulchra to current. No sponges were used. The two currents were adjusted so that one was very weak, and the other was much stronger. For the second experiment the currents were reversed.

(b) Six experiments were done to test the ability of Rostanga pulchra to find Ophlitaspongia pennata. Plastic bags which contained O. pennata and Halichondria panicea were tied in the incurrent water. The currents were adjusted to equal size. Both currents were small to reduce swirling of water in the dish. The sponges were switched from one current to the other between experiments.

(c) In order to compare the response to current and to the sponge, an experiment similar to (a) was set up with Ophlitaspongia pennata in the weak current.

II. Since Archidoris montereyensis is much larger than Rostanga pulchra, a larger apparatus was required. A tank 16 by 20 inches was set up similarly to that used for R. pulchra. Responses to food and current were tested as described in I(a) and I(b).

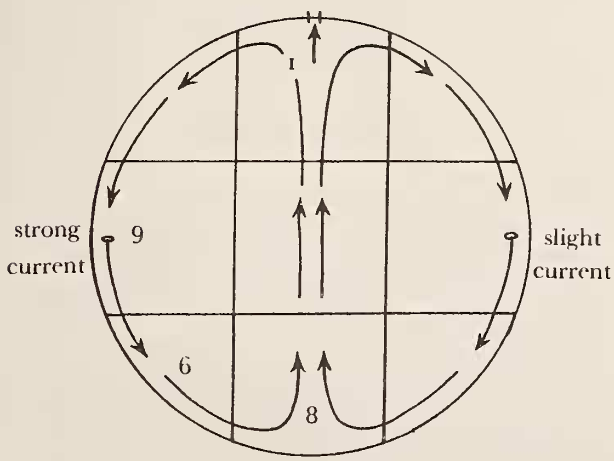

Figure 2

Distribution of *Rostanga pulchra* in response to current

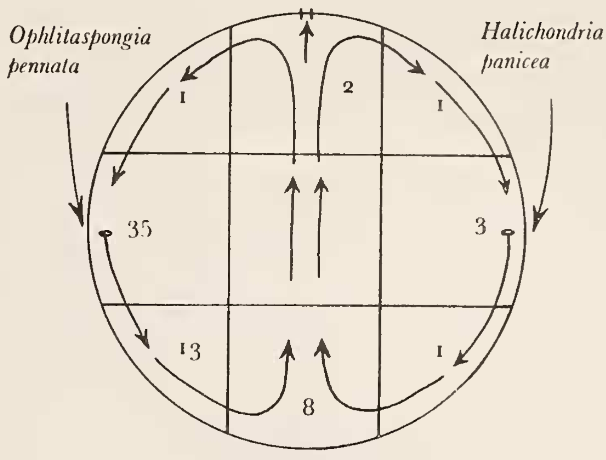

Figure 3

Distribution of *Rostanga pulchra* given a choice between *Ophlitaspongia pennata* and *Halichondria panicea*

III. Both nudibranchs were placed on different sponges to determine which they would eat. The sponges used were Halichondria panicea, Ophlitaspongia pennata, Syringella amphispicula, Aplysilla glacialis, and an unidentified suberitid.

Results

I(a) The results of experiments to determine the response of Rostanga pulchra to current indicate that it will move towards the current. The distribution of animals in the apparatus at the end of the experiment is shown in Figure 2. The specimen near the overflow was the first to leave the starting dish and it moved towards the current. Of a total of 25 animals 66 percent moved towards the current, 34 percent showed no detectable response.

I(b) The results of food selection experiments indicate that, in the laboratory, Rostanga pulchra is able to find Ophlitaspongia pennata by means of chemical sense. The results of six experiments are summarized in Figure 3. Of the 72 animals used, 8 were floating in the surface film at the end of the experiments and are not included. Of the remaining 64 animals, 76.7 percent showed a definite movement towards the current from O. pennata.

I(c) When the current was strong on one side of the apparatus and the red sponge was in the other current, the animals at first oriented into the current. At the end of the experiment, 83.3 percent of the 12 animals used had moved towards the current from the sponge (Figure 4).